

**DROUGHTS AND CANNIBALISTIC RESPONSES OF THE
WATER-STRIDER, *GERRIS MARGINATUS* SAY.**

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INTRODUCTION.

Recently, I made a rather extensive examination of much of the literature on American aquatic Heteroptera and I was interested to learn that there was practically no information on the cannibalistic responses of water-striders. Undoubtedly, it must be known that these insects, under certain conditions, feed on other members of the family to which they belong. To my surprise, I was able to find two records only—both of them comparatively recent—that made any reference to these peculiar feeding traits among gerrids. The first one was by Essenberg¹ (p. 398), who makes the following statement with respect to *Gerris orba* Stal:

Gerris remigis [*orba*] is very voracious and will eat any animal matter, not disdaining its own kind. . . . In the aquarium, where there is less chance of escape, the young nymphs usually fall victims to the adults, and the stronger ones, as a rule, feed upon their weaker companions.

The second reference was a statement by de la Torre-Bueno² (p. 203). In some remarks on the feeding responses of *Gerris remigis* Say, while in captivity, he states that:

If sufficiently hungry they [*Gerris remigis*] will feed on their own nymphs and even on each other.

Apparently, the remarks of both of these observers refer to gerrids in captivity, although it is possible that Essenberg also has made observations of a similar character in the field, but, from the context, this is doubtful. No other observations of this sort have

¹ Essenberg, C., "The Habits of the Water-Strider, *Geris remigis* [Orba]," Jour. Animal Behavior, Vol. V (1915), pp. 397-402.

² De la Torre-Bueno, J. R., "Life History and Habits of the Larger Water-strider, *Gerris remigis* Say (Hem.)," Entom. News, Vol. XXVIII (1917), pp. 201-208.

come to my notice and I have not found one definite statement with respect to the cannibalism of water-striders in their own environment. Therefore, I shall record in this paper some observations of my own—made near Urbana, Illinois, during the summers and autumns of 1911-1913 inclusive—on the cannibalistic responses of *Gerris marginatus* Say, in its own habitat.

DESCRIPTION OF HABITAT.

The observations, that now are to be recorded, were made in connection with a small intermittent stream situated about one mile northeast of Urbana, Illinois. It flows in a general north-westerly direction, receiving some sewage in its course, but the water is usually clear. The brook has a muddy bottom, with short herbaceous vegetation along its margins. There are no trees along the greater part of its course, therefore the water receives little shade. In width it varies from about two feet to five feet, with a depth seldom more than six inches, and frequently less than this. The current is sluggish in many places, while in others it runs more rapidly. In general, however, the current is slow and there are areas of quiet water, which are almost pool-like in character.

Such a stream forms a habitat well suited to the general responses of *Gerris marginatus*, but it is not of the character where *Gerris remigis* Say is usually found. The former species has been observed on the surface of this brook for several successive seasons, in greater or lesser numbers; but the latter species has not been found anywhere in this habitat. I frequently have taken *Gerris marginatus*, both alate and apterous individuals, from this stream. They congregate in small groups on the surface-film, usually where there is little current. Often they are found along the margins, among the aquatic plants and also in small bays formed by the land jutting out into the water.

EFFECT OF DROUGHT ON HABITAT.

It has been stated that the stream under discussion is a sluggish one and that in many places along its course there are reaches of quiet water. There is not that succession of shallow rapids and deeper pools which is so common in swift intermittent streams of this size. *Gerris marginatus* inhabits the surface-film of this

stream from early spring until late fall, with the exception of certain periods during times of drought. These periods of dry weather occur, usually, in the months of July and August, and sometimes in the early part of September. This does not mean that a continuous drought always exists throughout these months, although a drought may persist, with some intermittent rains, through this period. However, it is more likely to be in evidence during parts of all three months, but it may occur in only two of them, July and August.

As the drought develops, the water in such a stream decreases in amount rather rapidly, until there is produced a series of pool-like formations connected by means of narrow bands of flowing water. If the dry weather continues, this condition does not persist very long. The areas of flowing water disappear, leaving a succession of isolated shallow pools. It has been stated that the stream under normal conditions is shallow, its depth being usually about six inches, although portions of it are somewhat deeper than this. Therefore, the pool-like areas and the linked bands of flowing water are only a few inches deep. While this condition is somewhat comparable with the intermittent riffle and pool stage existing in swiftly flowing streams, during early periods of drought, yet there are not found the deep pools and alternating shallow riffles so common in such streams.

EFFECT OF DROUGHT ON MIGRATION AND FOOD-SUPPLY.³

At the inception of the drought, there is little difference between those areas of the stream that become pools and those that become the connecting links of flowing water. The former are in the deeper and quieter water, while the latter are in the shallower and more agitated water. Although water-striders are found to be more abundant on the deeper and quieter water than elsewhere, except near the shore, they are present also, in few numbers, on the shallower and more agitated water. However, as the water decreases in volume, these insects are observed to collect in greater

³ For a discussion of a somewhat similar phase of this subject, attention is directed to another of my papers: Riley, C. F. C., "Migratory Responses of Water-Striders During Severe Droughts," *BULL. BROOKLYN ENTOM. SOC.*, Vol. XV (1920), pp. 1-10.

and greater numbers on those areas which are to become pools, and it is noticed that they leave those parts which will become the links of flowing water connecting the pools. The decrease in amount of water emphasizes the action of the current in the latter areas, therefore these become unsuitable haunts for *Gerris marginatus*. As the dry weather continues and the water shrinks in volume still more, the narrow bands of running water entirely disappear. The stream now consists of a series of very shallow isolated pools. The water-striders must either migrate or become trapped on the surface-film of these pools of water. I believe that migration does occur—but I cannot say how frequently—under these conditions, because sometimes I have observed a decrease in the numbers of winged adults from one day to another. The migratory response probably takes place at night. I have not observed the act of migration just at the period when the habitat changes from a condition of running water to one of isolated pools.

Occasionally, throughout such periods of drought, pools persist, on which water-striders may remain—if there is a sufficient amount of food—until the period of dry weather has passed. In such situations, and under such circumstances they continue to feed, to copulate, and to engage in other daily responses. The various breeding responses are performed under such conditions, and many nymphs in different stages of development are found. If the drought is not too severe, there will be enough floating insect food on the surface of the pools, for the needs of the water-striders, and they will be tided over until the rains come. The dry weather may prove so persistent that—even should the pools of water continue to exist—there may be a dearth in the food-supply. Under such conditions, the water-striders migrate to some larger body of water.

CANNIBALISTIC RESPONSES: THEIR RELATION TO MIGRATION AND FOOD-SUPPLY.

Lack of food *per se* does not always result in the migratory response, but the water-striders develop cannibalistic “habits” and attack other weaker adult individuals and the nymphs of their own species. By attacking their own kind, the more vigorous water-striders survive and manage to tide over this period of semistarva-

tion, until the rain comes, and with it more food. Even if precipitation proves to be very intermittent and the pool stage in parts of the stream continues until late fall, the stronger, more agile water-striders survive owing to the cannibalistic response referred to. However, it should be stated that many individuals migrate before scarcity of food reaches the starvation point. If they are unsuccessful in their attacks upon individuals of their own kind, and there is no other food, they may migrate. In fact, the disturbance caused by such attacks may of itself be a strong factor in inducing the migrating response.

On the other hand, there may be an abundant food-supply, but, owing to the drought, the water in the pools may evaporate rapidly. This is especially the case in exposed situations—situations in which there are no trees along the banks of the stream to protect it from the hot rays of the midsummer sun—as is the case of the stream under consideration. In such cases the water-striders migrate when the pools become dry.

Sometimes, during such droughts, in small streams of this character, the pools become very restricted in area. Frequently, they are so small that the surface dimensions are not more than twenty inches in length by twelve inches in width, and they may have an area even smaller than indicated here. It is evident that in such pools, the cannibalistic activities of certain individuals are more in evidence than is the case in pools of larger areas. Occasionally, I have observed as many as seventy-five water-striders, both adults and nymphs, in a pool of the dimensions stated. Those individuals with cannibalistic "habits" cause much disturbance and activity among the other members of the water-strider population of the pool by their attacks on them. Sometimes vigorous contests ensue before the attacker vanquishes its victim. Weak and sluggish individuals are usually devoured first; but frequently the cannibalistic water-strider attacks and attempts to seize healthy, vigorous specimens. Generally, these escape the fate of their weaker associates, but sometimes one is captured by the attacker. Then a struggle ensues; and the "intended" victim may or may not escape, for this contingency depends upon its agility and strength.

When such attacks occur and are continued, the other water-strider inhabitants of the pool stride away in various directions to

avoid these encounters. As the surface area of the pool becomes more and more restricted, persistent attacks of this sort frequently cause the molested individuals to migrate by flight. Water-striders that have not been attacked directly, but, in the commotion of the chase, have scurried about from one part of the pool to another, also may eventually migrate. However, it is a matter of interest to observe how much of this sort of disturbance, the other water-striders will endure before they leave the pool. They employ various responses in order to escape their cannibalistic associates. They stride rapidly back and forth over the surface-film, and sometimes make short jumps from it, when closely pursued. Occasionally, when about to be seized by their attacker, they rise from the water-film and hazard brief flights. On occasion, during such attacks, they have been observed to stride from the surface-film onto the narrow area of mud-flat surrounding the pool, and to move, by jumping in an ungainly fashion, for a few inches away from the pool. Under such circumstances, it is my observation that, after the lapse of a few minutes, they return to the water-film.

In this connection attention is directed to certain water-strider responses observed by Weiss⁴ (p. 33) who noticed that when apterous specimens of *Gerris marginatus* are taken from a pond, they immediately return to the water, and accomplish this without "hesitation." However, it should be stated that the pond was very much larger than any of the pools under consideration, for it contained about "three thousand square feet of water." The water-striders were "liberated at distances of one, two, three, four, five, six, seven, eight, and nine yards" from the pond. Essenberg⁵ has observed the movements on the land, of *Gerris orba*, a congener of *Gerris marginatus*, with respect to which, she makes the following remarks:

Gerris remigis [orba] can live on land as well as in water. It runs with a jerking motion, making from four to six jumps in succession and then making a short stop. Very often it

⁴ Weiss, H. B., "Notes on the Positive Hydrotropism of *Gerris Marginatus* Say and *Dineutes Assimilis* Aube," Can. Entom., Vol. XLVI (1914), pp. 33-34.

⁵ Loc. cit., p. 399.

turns a somersault and continues running without interrupting its course until it reaches a place of safety. There it lies quietly for from fifteen to twenty-five minutes, then suddenly begins its race again.

Gerris remigis, a species closely related to *Gerris marginatus* and to *Gerris orba*, can live and readily move about on the land. In a series of papers by me⁶ there is considerable discussion of the responses and locomotion of *Gerris remigis*, after the water in its brook habitat has completely disappeared, due to drought, and the individual gerrids are found in the dry bed of the stream. There are also records of observations on the ability of these insects to find water after having been removed from it.

Attention has been directed to the fact that *Gerris marginatus* may be induced to leave, temporarily, a pool of water and to move onto the adjacent mud-flat, and that the water-striders even may be caused to migrate from the pool by flight. It is interesting to notice that both these responses are due to the stimuli of repeated cannibalistic attacks of certain members of their own kind. It has been stated that the stimuli that produce these responses, cause much disturbance among the water-striders on the surface-film of the pool, and that there is much rapid movement—striding back and forth over the water-film, jumping from the surface, or even short flights over it—on the part of these insects.

It is rather curious to observe that stimuli of a somewhat different character—as for example, sweeping the collecting net just above and through the water, wading through the water, or beating the surface-film with a leafy branch of a tree—produces the various responses, striding, jumping, and flying, enumerated just recently. However, these stimuli do not cause the water-striders to migrate by flight, or even to move off the surface-film onto the land. It is somewhat strange that stimuli of the character described—manifestly much more vigorous, and ostensibly resulting in greater disturbance and apparent discomfort to the water-striders than the cannibalistic attacks of their associates—neither provoke *Gerris*

⁶ Loc. cit. Ibid., "Some Habitat Responses of the Large Water-Strider, *Gerris Remigis* Say," *Amer. Nat.*, Vol. LIII (1919), pp. 394-414, 483-505; Vol. LIV (1920), pp. 68-83.

ris marginatus to migrate by flight, nor to move from the surface-film onto the land, in order to escape such unusual conditions. Essenberg⁷ noticed different results in her observations of *Gerris orba*. She makes the following statement:

When disturbed while on the water the insects betake themselves quickly to the land or among the weeds, and hide by clinging to the lower surface of the leaves or by lying quietly on the ground.

In this connection it may be stated that it is very difficult to induce the flying responses on the part of *Gerris marginatus*; but I have invoked the response by the following procedure: Place a water-strider in a test tube, closing it by means of a cork, and leave the gerrid within for some thirty minutes or more. At the close of this time remove the cork and project the mouth of the test tube a few inches beyond the outer window sill of a third or fourth story window. Now permit the insect to escape and it will drop for some distance, without spreading its wings, but, usually, before reaching the ground it responds by flying away.

CONCLUSION.

Cannibalism in *Gerris marginatus* has been observed by me in a few isolated instances, when the water-striders were *confined* in an aquarium, and also on a *very few* occasions, in their normal habitat, previous to the observations recorded in this paper. However, it is not evident, at least from my own experience, that cannibalism is a common, normal form of activity. In these instances that have been mentioned, the victims usually have been either weak or water-logged adults, or defenceless, non-agile nymphs. Cannibalism generally occurs during periods of stress or of great scarcity of food and probably is not a normal phase of behavior, but is rather of a sporadic character. It is likely that the instinct—the response—remains dormant, in a very large measure, until the necessary stimulation arouses it into full action.

During severe and long-continued droughts, extending over a large area of territory, accompanied—as they often are—by a decided scarcity of food supply, there is the possibility of great

⁷ Loc. cit., p. 398.

numbers of gerrids dying through starvation. This is likely to be the case notwithstanding the fact that the alate individuals may migrate. In fact, it is quite possible that all the members of the species may be destroyed in certain unfavorable and drought-stricken regions. It is probable that the actual operation of this, more or less dormant but potential, cannibalistic response in *Gerris marginatus* is not entirely a harmful form of behavior, but on the other hand, it is quite within the bounds of probability that such an activity is of a more or less beneficial character to the species itself—as, due to this cannibalistic trait, the stronger individuals are preserved to perpetuate the race—although it may not be so, always, to the individual.

A NEW BORBORID FROM MARYLAND (DIPTERA, BORBORIDAE).

By J. R. MALLOCH, Washington, D. C.

Leptocera intrudens sp. n.

Male.—Black, shining. Head yellow, ocellar region brownish, antennae fuscous. Thorax unicolorous black. Abdomen more distinctly shining than thorax, the hypopygium glossy. Legs yellowish, mid and hind pairs darker. Wings brownish fuscous, with a narrow fascia beyond crossveins and the apex of wing broadly hyaline. Halteres fuscous.

Frons with very minute interfrontal hairs, each orbit with 1 bristle; arista pubescent, long and filiform; vibrissa slender. Thorax with 2 pairs of dorsocentrals; scutellum with 4 bristles, the basal pair shortest. Hypopygium stout. Tibial bristles very short. Venation as in *meridionalis* Malloch.

Length 1 mm.

Type, Beltsville, Md., May 21, 1922 (J. R. Malloch). The type specimen is in the author's collection.

This species is the only one known to me from this country which has the wings maculated. Several Costa Rican species belong to the same group.